

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2
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PDA WITH INTEGRATED ADDRESS BOOK AND ELECTRONIC MAP WAYPOINTS

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PDA WITH INTEGRATED ADDRESS BOOK
AND ELECTRONIC MAP WAYPOINTS

Field of the Invention

The present invention relates generally to Personal Data Assistants (PDAs) and, more particularly, to PDAs with Global Positioning System (GPS) features.

Background of the Invention

PDAs are small, substantially hand-held computers that are used for storing, manipulating and retrieving data. One example of a PDA is the Palm Pilot® manufactured by 3Com Corporation. PDAs provide a variety of functions, such as an electronic day planner, an address book, a to do list, and a memo pad.

Electronic navigation devices employing Global Positioning System ("GPS") receivers are known. The GPS includes a plurality of satellites that are in orbit about the Earth. The orbit of each satellite is not necessarily synchronous with the orbits of other satellites and, in fact, is likely asynchronous. The GPS receiver device receives spread spectrum GPS satellite signals from the various satellites. The spread spectrum signals continuously transmitted from each satellite utilize a highly accurate frequency standard accomplished with an extremely accurate atomic clock. Each satellite, as part of its data signal transmission, transmits a data stream indicative of that particular satellite. The GPS receiver device acquires spread spectrum GPS satellite signals from at least three satellites to calculate its two-dimensional position by triangulation. Acquisition of an additional signal, resulting in signals from a total of four satellites, permits the GPS receiver device to calculate its three-dimensional position. In this manner, an electronic navigation device employing a GPS receiver has the ability to accurately compute the position of the device in real time, even as the device moves. One example of an electronic

navigation device is the eMAP portable electronic map manufactured by Garmin International.

Plug-in GPS receiver modules for PDAs are known. There are problems associated with various plug-in GPS receiver modules and PDAs. One problem is that a PDA with a plug-in GPS receiver module is cumbersome to handle and use. Two separate devices must be handled. Additionally, the plug-in GPS receiver module and the PDA do not function together to provide integrated PDA features.

Therefore, there exists a need for a PDA that incorporates GPS receiver technology within a single module, and that further integrates GPS capabilities into PDA functions such that the GPS-capable PDA is not cumbersome to handle or to use.

Summary of the Invention

The present invention addresses problems with integrating GPS receiver technology into a PDA, and will be understood by reading and studying the following specification. The systems, devices and methods of the present invention integrate GPS capabilities with PDA functions. In particular, the systems, devices and methods of the present invention integrate a PDA address book function with an electronic map that has GPS capabilities.

One aspect provided herein is a method. In one embodiment, a location for an electronic map is identified, and a Personal Digital Assistant (PDA) address book entry is associated with the location. In one embodiment, electronic map feature data associated with the location is identified, and the PDA address book entry is pre-filled using the electronic map feature data associated with the location. According to one method embodiment, a PDA address book entry is selected, and a location for an electronic map is associated with the PDA address book entry.

One aspect provided herein is a data structure for use by a PDA for linking PDA address book entries and electronic map locations and/or features. According

to one embodiment, the data structure includes a field representing a latitude, and a field representing a longitude. In one embodiment, the field representing a latitude and the field representing a longitude includes a data string contained within a custom field in a PDA address book entry. According to one embodiment, the data structure further includes a field representing a symbol associated with the waypoint, and a field representing an altitude.

One aspect provided herein is a PDA device with an integrated electronic map and address book. According to one embodiment, the PDA device includes a processor and a memory adapted to communicate to the processor. Address book data and electronic map data are contained within the memory. In one embodiment, the electronic map data is contained in a map data cartridge. The PDA device is adapted to associate a waypoint for the electronic map with a PDA address book entry.

These and other aspects, embodiments, advantages, and features of the present invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art by reference to the following description of the invention and referenced drawings or by practice of the invention. The aspects, advantages, and features of the invention are realized and attained by means of the instrumentalities, procedures, and combinations particularly pointed out in the appended claims.

Brief Description of the Drawings

Figure 1A is a front view of a PDA with integrated GPS receiver according to the present invention;

Figure 1B is a side view of the PDA shown in Figure 1;

Figure 1C is a top end view of the PDA shown in Figure 1;

Figure 2 is a block diagram of components in one PDA embodiment;

Figure 3 is a representation of an address list screen for one PDA embodiment according to the present invention;

Figure 4 is a representation of an address view screen for one PDA embodiment according to the present invention;

Figure 5 is a representation of an address edit screen for one PDA embodiment according to the present invention;

Figure 6 is a representation of a map screen for one PDA embodiment according to the present invention;

Figure 7 is a representation of a PDA architecture according to the present invention;

Figure 8 is a representation of linked PDA address book data and electronic map data according to the present invention;

Figure 9 is a flow diagram of one method embodiment according to the present invention;

Figure 10 is a flow diagram of one method embodiment according to the present invention;

Figure 11 illustrates one embodiment for estimating an address within an address range;

Figure 12A-12E illustrate, in various levels of detail, an embodiment of a data structure for use by a PDA for linking PDA address book entries and locations/features such as electronic map features;

Figure 13 is a representation of an Address List Screen for one PDA embodiment according to the present invention;

Figure 14 is a representation of an Address View Screen for one PDA embodiment according to the present invention;

Figure 15 is a representation of custom fields for the Address View Screen of Figure 14 when information exists in the Custom 4 Field that is not in a prescribed format;

Figure 16 is a representation of custom fields for the Address View Screen of Figure 14 when no information exists in the Custom 4 Field or if the information is in a prescribed format;

Figure 17 is a representation of an Address Edit Screen for one PDA embodiment according to the present invention;

Figure 18 is a representation of custom fields for the Address Edit Screen of Figure 17 when information exists in the Custom 4 Field that is not in a prescribed format;

Figure 19 is a representation of custom fields for the Address Edit Screen of Figure 17 when no information exists in the Custom 4 Field or if the information is in a prescribed format;

Figure 20 is a representation of a Map View for an Address Location Form for one PDA embodiment according to the present invention;

Figure 21 is a representation of a Details View for an Address Location Form for one PDA embodiment according to the present invention;

Figure 22 is a representation of an Edit Symbol Screen for one PDA embodiment according to the present invention;

Figure 23 is a representation of a Set/Edit Location Dialog Box for one PDA embodiment according to the present invention;

Figure 24 is a representation of a screen for changing locations manually for one PDA embodiment according to the present invention;

Figure 25 is a representation of a notification box that the Custom 4 Field is in use according to one PDA embodiment according to the present invention; and

Figure 26 is a representation of a Move Custom 4 Field box for one PDA embodiment according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description of the invention, reference is made to the accompanying drawings which form a part hereof, and in which is shown, by way of illustration, specific embodiments in which the invention may be practiced. The embodiments are intended to describe aspects of the invention in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and changes may be made without departing from the scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims, along with the full scope of equivalents to which such claims are entitled.

The present invention is drawn to systems, devices and methods for integrating GPS receiver technology into a PDA and for integrating capabilities associated with GPS and electronic map technologies with PDA functions. The present invention integrates a PDA address book function with an electronic map and GPS capabilities. The present invention is capable of associating an address with a position such as that provided by latitude and longitude coordinates for two dimensions, and an altitude value for three dimensions. A position is capable of being identified from an address, and an address is capable of being identified or estimated from a location.

Figures 1A-1C illustrate views for a personal digital assistant (PDA) with integrated Global Positioning System (GPS) receiver according to the teachings of the present invention. The GPS integrated PDA operates with an operating system (OS) such as, for example, the well-known Palm or Pocket PC operating systems, or the currently lesser-used Linux OS.

As shown in the front view of Figure 1A, the GPS integrated PDA 110 includes a GPS antenna, illustrated in this embodiment as an internal integrated GPS patch antenna 114 contained within a housing 118. As one of ordinary skill in the

art will understand, the antenna can include other antenna designs such as a helical GPS antenna. The invention is not so limited. The housing 118 in the illustrated embodiment is generally rectangular with a low profile and has a front face 120 extending from a top end 122 to a bottom end 124. Mounted on front face 120 is a display screen 126, which is touch sensitive and responsive to a stylus 130 (shown stored in the side view of Figure 1B) or a finger touch. Figures 1A-1C illustrate the stylus 130 nested within housing 118 for storage and convenient access in a conventional manner.

The embodiment shown in Figure 1A illustrates a number of control buttons, or input keys 128 positioned toward the bottom end 124. The invention, however, is not so limited and one of ordinary skill in the art will appreciate that the input keys 128 can be positioned toward the top end 122 or at any other suitable location.

The end view of Figure 1C illustrates a map data cartridge bay slot 132 and headphone jack 134 provided at the top end 122 of the housing 118. Again, the invention is not so limited and one of ordinary skill in the art will appreciate that a map data cartridge bay slot 132 and headphone jack 134 can be provided at the bottom end 124, separately at opposite ends, or at any other suitable location.

One embodiment of the GPS integrated PDA 110 has the capability to wirelessly communicate with other PDAs or with other systems using a variety of wireless communication technology, such a satellite, radio frequency, microwave frequency and infrared communication, and the like. One embodiment of the GPS integrated PDA 110 includes a cellular transceiver 116 contained in the housing 118. The cellular transceiver is used in cellular communication technology, such as time division multiple access (TDMA), frequency division multiple access (FDMA), code division multiple access (CDMA), global system for mobile communications (GSM), and the like. According to various embodiments, the wireless communication includes digital and analog signals. According to various

embodiments, these signals are modulated, encrypted and/or compressed signals as may be desirable for the communication technology.

Figure 2 is a block diagram of components in one PDA embodiment. In one embodiment, the electronic circuit for a PDA with an integrated GPS receiver includes a processor 236 that interacts with an operating system (such as PalmOS; Pocket PC) that runs selected software depending on the intended use of the PDA. Processor 236 is coupled with memory 242 such as RAM via line 244, and power source 246 for powering the electronic components of the PDA. The processor 236 communicates with a touch sensitive display screen 226 via data line 248. The electronic circuit further includes two other input sources that are connected to the processor 236. Control buttons 228 are connected to processor 236 via line 250 and a map data cartridge 233 inserted into cartridge bay 232 is connected via line 252. A conventional USB or serial I/O port 254 is connected to the processor 236 via line 256.

The PDA is integrated with GPS capabilities using a GPS receiver 238. A GPS antenna 214 is connected to the GPS receiver 238, and the GPS receiver 238 is connected to the processor 236 via line 240. The GPS antenna 214 is a patch antenna in one embodiment and a helical antenna in another embodiment.

One embodiment of the PDA with an integrated GPS receiver includes cellular communication capabilities. A cellular antenna 216 is connected to a cellular transceiver 258, which is connected to the processor 236 via line 260. Processor 236 is connected to the speaker/headphone jack 234 via line 262. According to one embodiment, the PDA 210 includes an infrared port (not shown) coupled to the processor 236 that is capable of being used to beam information from one PDA to another.

The processor 236 accesses some form of computer-readable media. Computer-readable media include any available media that is accessible by the processor. By way of example and not limitation, computer-readable media include

computer storage media and communications media. Computer storage media, or memory, includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Communication media specifically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above would also be included within the scope of computer-readable media.

Figure 3 is a representation of an Address List Screen for one PDA embodiment according to the present invention. The Address List screen, denoted generally by reference number 310, is presented on the display screen 126 of Figure 1 when the PDA electronic address book software application is conventionally selected and run. A list of names 312 is displayed along with phone numbers 314, a designator 316 to indicate a work (W) or home (H) phone number, and an attached electronic note indicator 318. Also shown is a waypoint indicator 320 which indicates that the address associated with corresponding name has been saved as a waypoint for use in electronic map or GPS applications.

Waypoints are used in electronic map or GPS applications as intended destinations, points of interest and to build routes, for example. A waypoint, in general, can be any identified location such as coordinates or an electronic map feature. An electronic map feature is a location that is associated with other information such as, for example, a name, address, telephone number, and the like,

for the location. Waypoints are used herein to identify a location or electronic map feature that is associated with a PDA address book entry.

Figure 4 is a representation of an Address View Screen for one PDA embodiment according to the present invention. This Address View Screen is displayed when the name "Patrick Keller" is conventionally selected in the Address List Screen 310 of Figure 3. The Address View Screen is denoted generally by reference numeral 410. Selection of the Waypoint button 412 stores an electronic GPS coordinate corresponding to the displayed address identified by the displayed name. One embodiment of the GPS integrated PDA is capable of storing five hundred or more waypoints in memory. Selecting the Goto button 414 displays a course from the present location of the PDA to the waypoint associated with the displayed address on the Address View Screen 410. In one embodiment in which a waypoint has not been stored for the displayed address, selecting the Goto button 414 automatically stores an associated waypoint and then displays an electronic map showing the course from the present location of the PDA to the displayed address. In another embodiment in which a waypoint has not been stored for the displayed address, the Goto button 414 is not available or is hidden. Indicator 416 is displayed to indicate that a waypoint has been stored for this address. As will be shown below in connection with Figures 5 and 6, selecting the Map button 418 displays an electronic map with the location of the address shown in screen 410. Selecting the Edit button 420 displays an Address Edit Screen.

Figure 5 is a representation of an Address Edit Screen for one PDA embodiment according to the present invention. The Address Edit Screen is denoted generally by reference numeral 510, and is displayed when the Edit button 420 is selected in the Address View Screen 410 of Figure 4. Selection of the Waypoint button 512 stores an electronic GPS coordinate corresponding to the displayed address identified by the displayed name. Selecting the Goto button 514 displays a course from the present location of the PDA to the waypoint associated with the

displayed address on the Address Edit Screen 510. In one embodiment in which a waypoint has not been stored for the displayed address, selection of the Goto button 514 automatically stores an associated waypoint and then displays an electronic map showing the course from the present location of the PDA to the displayed address. In another embodiment in which a waypoint has not been stored for the displayed address, the Goto button 514 is not available or is hidden. As will be shown below in connection with Figure 6, selecting the Map button 518 displays an electronic map with the location of the address shown in screen 510. According to various embodiments, the PDA is capable of providing navigational routes and guidance, such that the location of the address is not necessarily shown on the map at a given time.

Figure 6 is a representation of a Map Screen for one PDA embodiment according to the present invention. The Map Screen is denoted generally by reference numeral 610, and is displayed when the Map button 418 is selected in the Address View Screen 410 of Figure 4, or when the Map button 518 is selected in the Address Edit Screen 510 of Figure 5. The Map Screen of the GPS integrated PDA provides functions and features of a conventional portable navigational device such as the eMap manufactured by GARMIN International, for example. Integration of the map features of a portable navigation device with a PDA allows sharing of address information between the address book and the electronic map software applications.

For example, when the PDA displays a map, a location displayed on the PDA screen is capable of being selected using a stylus or other selection means to mark a waypoint or to display an address corresponding to the selected location. In one embodiment, if there is no name stored with this address, Address Edit Screen 510 shown in Figure 5 is displayed to prompt entry of a name in the name fields and other data.

In one embodiment of a GPS integrated PDA with cellular communication capabilities, the exact position of one PDA is capable of being displayed on another PDA unit or electronic device that has cellular communication capabilities and has the capability of receiving and displaying location information. The NavTalk device manufactured by GARMIN International is one such device that has the capability of receiving and displaying such location information.

Figure 7 is a representation of a PDA architecture according to the present invention. The PDA architecture is denoted generally by reference numeral 710. The PDA architecture includes PDA hardware 712, and is capable of including third party, OEM hardware such as GPS hardware 714. An operating system 716 operates on the hardware.

One of ordinary skill in the art will understand the operation and function of an operating system. A brief overview is provided here to assist the reader. One definition of an operating system is software that provides hardware control and user interaction. An operating system can be viewed as being divided into a loader, a kernel and utilities. These portions of the operating system are not illustrated, as such, in the PDA architecture 710 of Figure 7. A responsibility of the loader is, upon power up, loading the kernel of the operating system into memory and transferring control to the kernel. Tasks performed by the kernel of the operating system include controlling hardware, such as hardware initializations, and controlling some software initializations like internal data structures. The kernel also is able to set predetermined entry points to trusted code. The utilities are the outer layer of the operating system, which depend on kernel entry points to do hardware accesses. The utilities invoke other programs and transfer control to them. The operating system 716 is shown generally in Figure 7 as those components in the PDA architecture 710 that provide hardware control.

Figure 7 illustrates various layers on other layers. One of ordinary skill in the art will understand how these layers related with each other to provide an

operable PDA. In the illustration shown in Figure 7, a hardware abstraction layer 718 is illustrated on the hardware 712 and 714, and a kernel 720 is illustrated on the hardware abstraction layer 718. Both conventional PDA system services 722 and third party, OEM system services such as GPS services 724 are positioned on the hardware abstraction layer 718 on the kernel 720. PDA system libraries 726 are illustrated on the PDA system services 722 and third party, OEM system libraries 728 such as GPS system libraries are illustrated on the GPS system services 724. An application toolbar 730 is illustrated on the PDA system libraries 726 and the GPS system libraries 728. Various PDA applications 732 and GPS applications 734 can be launched from the application tool bar 730. PDA applications 732 include applications such as an address book application 736 and associated address book data 738. GPS applications include applications such as an electronic map application 740 and associated electronic map data 742, a routing application 744, and a guidance application 746. These GPS applications are capable of determining the real time position of a GPS receiver, *i.e.* the PDA device. According to one embodiment, the electronic map data 742 is provided on a map data cartridge such as the map data cartridge 233 shown in Figure 2. According to one embodiment, the electronic map data 742 is provided, at least in part, by a server through a wireless communication channel. According to one embodiment, the calculations associated with routing and guidance applications are provided, at least in part, by a server and are communicated to the PDA through a wireless communication channel. One of ordinary skill in the art will recognize that the integration of GPS capabilities into the PDA architecture 710 can be accomplished at the hardware level 714, the system services level 724, the system library level 728, and/or the applications level 734.

Figure 8 is a representation of linked PDA address book data and electronic map data according to the present invention. PDA address book data 838 includes a number of fields, such as a Name Field 852, a Phone Number field 854, an Address Field 856, Other or Custom Fields 858, and the like. A custom field is capable of

being implemented to store a variety of information as desired by the user. Data contained in these fields are grouped together and associated with a PDA address book entry. In one embodiment, electronic map data 842 includes fields such as a Name Field 862, an Address Field 864, a Symbol Field 866 associated with a location, location coordinates 868, and the like. As used herein, one definition of a waypoint is a location associated with a Name Field and a Symbol Field. For example, a waypoint can be used to calculate routes or to store location information for an electronic map. Additionally, waypoints are capable of being displayed on electronic maps using representative symbols to designate markers or turns. The present invention associates PDA address book entries and the electronic map data. That is, the present invention is capable of associating a position (via latitude and longitude coordinates, for example) to an address book entry such that a position can be determined from an address and an address can be determined from a position. In one embodiment, the present invention adds location information into a location field 860 in the PDA address book entry, and uses this location field to associate the address book entry to the electronic map data. In one embodiment, the location field 860 is a modified Other or Custom Field 858 found in a conventional PDA address book, and a data string that identifies a location is stored in the Custom Field 858.

Figure 9 is a flow diagram of one method embodiment according to the present invention. According to this embodiment, a PDA address book entry is selected at 910, and at 912 a location/feature for an electronic map is associated with the selected PDA address book entry. Locations/ features and any symbols associated therewith are able to be associated with existing PDA address book entries and with newly formed PDA address book entries. At 914, an application is performed using a waypoint that is formed by associating the electronic map location/feature with the PDA address book entry. These applications include, by way of example, displaying the waypoint on the electronic map, calculating a route to the waypoint, displaying a route to the waypoint, and providing navigational

guidance to the waypoint. In one embodiment, displaying a waypoint on the electronic map includes displaying an appropriate symbol for the waypoint, such as a red cross for a medical facility, or any other suitable symbol as appropriate for the given waypoint.

According to various embodiments, the navigational guidance includes visual guidance that provides turn arrows, text instructions and the like, and voice guidance that provides spoken navigational instructions to reach the waypoint. The following co-pending, commonly-assigned U.S. patent applications relate to guidance and are herein incorporated by reference: "Navigation System, Method and Device With Automatic Next Turn Page," attorney docket no. 1528.008US1, serial number _____, and "Navigation System, Method and Device With Voice Guidance," attorney docket no. 1528.009US1, serial number _____. According to one embodiment, the electronic map data is provided to a PDA on a map data cartridge. According to one embodiment, the electronic map data is provided to the PDA, at least in part, by a server through a wireless communication channel between the PDA and the server. According to one embodiment, the calculations associated with routing and guidance applications are provided to the PDA, at least in part, by a server and are communicated to the PDA through a wireless communication channel between the PDA and the server.

Figure 10 is a flow diagram of one method embodiment according to the present invention. According to this embodiment, a location/feature on an electronic map is identified at 1010. A PDA address book entry is associated with the identified location/feature at 1012 to form a waypoint for the PDA. According to one embodiment, at 1014 the PDA address book entry is pre-filled from electronic map data associated with the waypoint identified previously at 1010. The pre-filled PDA address book entry is capable of being edited at 1016. In one embodiment, the location/feature is identified by a GPS-determined position. That is, the GPS receiver receives signals from GPS satellites, from which the current

position of the PDA is determined. One of ordinary skill in the art will understand that navigational routing and guidance are capable of being performed using the GPS receiver to determine the position of the PDA with respect to waypoints. In one embodiment, the location/feature is identified by positioning a cursor on an electronic map. In one embodiment, the PDA address book entry to be associated with the identified location/feature is an existing PDA address book entry. In one embodiment, the PDA address book entry to be associated with the identified location/feature is newly created.

One of ordinary skill in the art will understand, upon reading and comprehending this disclosure, that the PDA device of the present invention is capable of performing a number of integrated GPS/address book functions. For example, a PDA user who is in a restaurant is able to use the GPS functions to identify the location of the restaurant for future use, and perhaps even the name and address if that information is available in the map data. Rather than create and store a separate waypoint for the electronic map, a PDA address book entry is capable of being created for that restaurant. This PDA address book entry is capable of being pre-filled with data already contained within the electronic map. According to the present invention, as will be described in more detail below with respect to Figure 11, addresses are able to be estimated from address ranges contained in the electronic map. The PDA user is able to edit the pre-filled data to provide a new or more descriptive name, or to provide a precise address. The PDA user also is able to add data to the PDA address book entry, such as a phone number, comments and a desired waypoint symbol. The PDA user is able to retrieve the PDA address book entry created from the location/feature, locate the restaurant on the electronic map, and receive navigational routing and guidance to the restaurant. As is clear upon reading and comprehending this disclosure, other integrated GPS/address book functions are available. As such, the above-described restaurant example should not be read to limit the invention.

Figure 11 illustrates one embodiment for estimating an address within an address range. In one embodiment, estimated address are used to pre-fill a PDA address book entry. According to this embodiment, the position 1146 of the PDA 1138 is determined via the GPS device methods described above. In Figure 11, for example, it is determined that the PDA 1138 is traveling on 51st Street. An address range 1148 is associated with the position of the PDA 1138. In the illustrated example, it is determined that the address number range 1148 is from "502" at 1150 to "598" at 1152. The distance traveled from the beginning of the address number range (502 51st Street) at 1150 to the position 1146 of the PDA 1138 is determined. An address is estimated based on the address number range 1148, the length 1154 of the road associated with the address range 1148, and the distance 1156 from the beginning of the address number range 1148 at 1150 to the position 1146 of the PDA 1138. An estimated address number 1158 is derived based on this information. In the illustrated example, the estimate proximate address 1158 is estimated to be "556". According to some local rules or standards, the address ranges on one side of the road are odd and on the other side of the road are even. The PDA 1138 is able to determine whether the desired estimated address number falls within the odd or even address range. Although this address is an estimation, it is noted that this estimation often will be enough to find or re-find the subject of the PDA address book entry. In the above-described restaurant example, the estimated address is close enough to travel back to and find the restaurant without the assistance of GPS guidance and the like.

Figure 12A-12E illustrate, in various levels of detail, an embodiment of a data structure for use by a PDA for linking PDA address book entries and locations/features such as electronic map features. A location is identified by coordinates in one embodiment. A feature includes additional data associated with the coordinates, such as a name, phone number, address and the like. The data structure is denoted generally by reference numeral 1210. In one embodiment, the

data structure 1210 is stored as a data string in a custom field of a PDA address book entry. The data string references or identifies a location, which is used to associate the PDA address book entry to the electronic map. The data string is capable of being stored in a Custom Field of a PDA address book entry to link the PDA address book entry to an electronic map, such as a map with GPS capabilities.

Referring to Figure 12A, the data structure includes a field 1212 representing a latitude and a field 1214 representing a longitude. The latitude and longitude fields are sufficient to associate the PDA address book entry to a 2-dimensional position on an electronic map. One embodiment of the data structure includes a field 1216 representing a symbol. The symbol is displayed on the map as a representation of a waypoint. For example, a red cross symbol is capable of being used to represent a medical facility, and an airplane symbol is capable of being used to represent an airport. One embodiment of the data structure 1210 includes a field 1218 representing an altitude. A 3-dimensional position is capable of being determined based on the latitude, longitude and altitude. One embodiment of the data structure 1210 includes a field 1220 representing a prefix which can, for example, be used to identify a type and format of the data string. The present invention is not limited to a particular order of these fields in the data string.

Referring to Figure 12B, one embodiment of the data structure includes spaces 1222 between fields that make up the data string or structure. Other delimiting marks, such as commas or semicolons, may be used in place of spaces 1222. The present invention is not limited to the use of delimiting marks, or to any particular type of delimiting marks.

Referring to Figure 12C, according to one embodiment, both the field 1212 representing a latitude and the field 1214 representing a longitude are 32 bit fields. The field 1216 representing a symbol is an 8 bit field, and the field 1218 representing the altitude is a 32-bit IEEE floating point field. An ID character 1224, such as the character B, is associated with the field 1216 representing a symbol and

an ID character 1226, such as the character A, is associated with the field 1218 representing an altitude. The present invention is not so limited, however.

Referring to Figure 12D, according to one embodiment, hexadecimal values are used in various fields. Hexadecimal values are designated in the figures as "H.D." The 32-bit fields 1212, 1214 and 1218 in Figure 12C are represented using an 8 character hexadecimal value ($2^{32} = 16^8$). The 8-bit field 1216 in Figure 12C is represented using a 2 character hexadecimal value ($2^8 = 16^2$).

Referring to Figure 12E, an example of the data string is shown. The data string is "GARMIN 1BA16FE0 BC965D9D B15 A43A28000". "GARMIN" is contained in the field 1220 representing a prefix; "1BA16FE0" is contained in the field 1212 representing a latitude; "BC965D9D" is contained in the field 1214 representing a longitude; "B15" is contained in the field 1216 representing a symbol; and "A43A28000" is contained in the field 1218 representing an altitude. The data string of this example provides a coded representation of 38.86 deg N, 47.40 deg W, symbol identifier 21, and 325 meters altitude. This data string is capable of being stored in a Custom Field in an PDA address book entry, and provides a location that is capable of being used to link the PDA address book entry to an electronic map.

Figures 13 - 26 illustrate one embodiment in which the location, symbol and altitude (such as presented above in connection with Figures 12A, 12B, 12C, 12D and 12E) are stored in a Custom 4 Field of a PDA address book entry. The embodiment represented in these figures maintain compatibility with conventional PDAs, such as Palm PDAs, and with conventional PDA desktop conduits. The present invention is not restricted to using a Custom 4 Field.

Figure 13 is a representation of an Address List Screen for one PDA embodiment according to the present invention. The rightmost column contains a symbol 1312 if the address record has an associated location. If the address record already has a location, tapping this symbol centers a main map on the location associated with the address record. If the address record does not have a location,

tapping the space where the symbol would otherwise be displays a Set Location Dialog Box, which is shown in Figure 23.

Figure 14 is a representation of an Address View Screen for one PDA embodiment according to the present invention. A "Location" button is present in place of a "New" button that is typically found in a conventional PDA address view screen. Tapping the Location button displays the Set Location Dialog Box, shown in Figure 23, if this address record is not associated with a location, and displays an Address Location Form, shown in Figures 20 and 21, if this address record is associated with a location. The symbol, if any, associated with the record is displayed on the Address View screen. A menu item is available to delete locations associated with PDA address book entries.

Figure 15 is a representation of custom fields (e.g. C1, C2, C3 and C4) for the Address View Screen of Figure 14 when information exists in the Custom 4 Field that is not in a prescribed format to link to map data, such as that shown in Figures 12A -12E. As illustrated, the Custom 4 Field label and data is displayed if there is information in the Custom 4 Field that is not in the prescribed format to link to map data, such as that shown in Figures 12A -12E.

Figure 16 is a representation of custom fields for the Address View Screen of Figure 14 when no information exists in the Custom 4 Field or if the information is in a prescribed format to link to map data. As illustrated, the Custom 4 Field label and data are hidden if there is no information in the Custom 4 Field, or the information is in the prescribed format to link to map data, such as that shown in Figures 12A -12E.

Figure 17 is a representation of an Address Edit Screen for one PDA embodiment according to the present invention. The symbol, if any, associated with the record is displayed on the Address Edit Screen. A menu item is available to delete locations associated with PDA address book entries.

Figure 18 is a representation of custom fields for the Address Edit Screen of Figure 17 when information exists in the Custom 4 Field that is not in a prescribed format to link to map data. As illustrated, the Custom 4 Field label and data is displayed if there is information in the Custom 4 Field that is not in the prescribed format to link to map data, such as that shown in Figures 12A -12E.

Figure 19 is a representation of custom fields for the Address Edit Screen of Figure 17 when no information exists in the Custom 4 Field or if the information is in a prescribed format to link to map data. As illustrated, the Custom 4 Field label and data are hidden if there is no information in the Custom 4 Field, or the information is in the prescribed format to link to map data, such as that shown in Figures 12A -12E.

According to this embodiment of the present invention, an Address Location Form is used to set and edit the location-related items of an address record. The Address Location Form is displayed when a Location button is tapped in the Address View Screen of Figure 14, for example. The Address Location form has a Map View and a Details View.

Figure 20 is a representation of a Map View for an Address Location Form for one PDA embodiment according to the present invention. The Map View is displayed the first time the Address Location Form is displayed after launching the address book. Selecting the Edit button displays the Address Edit Form for this address record. In one embodiment, such as shown in Figure 20, the displayed map is centered on the location of the address record. The hardware up/down keys change the map zoom.

Figure 21 is a representation of a Details View for an Address Location Form for one PDA embodiment according to the present invention. The Details View displays and allows editing of the details of the location associated with a PDA Address Book Entry. Tapping the name or the Edit button displays the Address Edit Form for this address record.

Figure 22 is a representation of an Edit Symbol Screen for one PDA embodiment according to the present invention. Tapping a symbol highlights the symbol and displays its description. Tapping the scroll buttons displays next/previous pages of symbols. Tapping the OK button closes the dialog box and assigns the currently highlighted symbol to the address record. Tapping the cancel button closes the dialog box and keeps the current symbol.

In one embodiment, a Set/Edit Location Dialog Box is used to allow a user to choose the method for changing the location. The altitude is able to be edited in place as it is a standard numeric text field for a conventional PDA.

Figure 23 is a representation of a Set/Edit Location Dialog Box for one PDA embodiment according to the present invention. This dialog box is able to be reached six ways in this embodiment. One way for reaching this dialog box is by tapping the space where the symbol would be from the Address List form, such as shown in Figure 13, for an address record that does not have a location. In this instance, the title of the dialog box is Set Location. Another way for reaching this dialog box is by tapping the Location button from the Address View Form, such as shown in Figure 14, for an address record that does not have a location. In this instance, the title is Set Location. Another way for reaching this dialog box is by tapping the location from the Details View of the Address Location Form, such as shown in Figure 21. In this instance, the title is Edit Location. Other ways for reaching this dialog box uses menus in the Address View page, menus in the Address Edit page, and menus in the Address Location page. The text is set accordingly to reflect if it is a "Set" or "Edit."

A user is capable of editing the location using the Find button, the Manual button or the Map button. In one embodiment, tapping the Find button in the display of Figure 23 displays the Find Address Form, which is populated with number, street, city and postal code fields from the address record.

Figure 24 is a representation of a screen for changing locations manually for one PDA embodiment according to the present invention. Tapping the Manual button in the display of Figure 23 displays the Set New Location dialog box, which allows the user to manually enter the location. Selecting user grid from the location format list displays a dialog box which allows the user to enter the user grid parameters.

Tapping the Map button in the display of Figure 23 displays a map on which the user can tap to indicate the location to be used. This map includes a Checkmark and an X. Tapping the checkmark sets the location of the address record to the location indicated on the map. Tapping the X closes the map without changing the location of the address record.

Figure 25 is a representation of a notification box that the Custom 4 Field is in use according to one PDA embodiment according to the present invention. In other words, the notification box indicates that the Custom 4 Field is storing data that is not in the prescribed format. Tapping the OK button associates a location by storing the location data string in the Custom 4 Field without first saving the Custom 4 Field data. Tapping the Cancel button cancels the pending association with a location. Tapping the Move button displays a dialog box that displays the beginning of the current Custom 4 Field data and allows a user to select a place to move the Custom 4 data.

Figure 26 is a representation of a Move Custom 4 Field box for one PDA embodiment according to the present invention. This box is displayed after tapping the Move button in the display of Figure 25. Any empty custom field is in the list. Tapping one of the empty custom fields and tapping Move moves the data from the Custom 4 Field to the selected Custom Field. In one embodiment, the Note Field is always in the list. Tapping Note and then tapping Move creates a new note containing the data from the Custom 4 Field if a note does not currently exist, and

appends the data from the Custom 4 Field to data in the note if the note already exists.

The present invention may also be described in the context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types.

As one of ordinary skill in the art will understand upon reading and comprehending this disclosure, any one or more of the above features can be combined into a particular embodiment of the invention. Likewise, in the invention any one or a combination of the above functions can be optionally de-activated in the device. One of ordinary skill in the art will further understand that the method includes using a computer accessible medium having a set of computer executable instructions operable to perform the method. Other embodiments may be utilized and structural, logical, and electrical changes may be made without departing from the scope of the present invention.

In some embodiments, the methods provided above are implemented as a computer data signal embodied in a carrier wave or propagated signal that represents a sequence of instructions which, when executed by a processor, such as processor 236 in Figure 2, cause the processor to perform the respective method. In other embodiments, methods provided above are implemented as a set of instructions contained on a computer-accessible medium, such as memory 242 in Figure 2, capable of directing a processor, such as processor 236 in Figure 2, to perform the respective method. In varying embodiments, the medium includes a magnetic medium, an electronic medium, or an optical medium.

The system of the present invention includes software operative on a processor to perform methods according to the teachings of the present invention. One of ordinary skill in the art will understand, upon reading and comprehending

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this disclosure, the manner in which a software program can be launched from a computer readable medium in a computer based system to execute the functions defined in the software program. One of ordinary skill in the art will further understand the various programming languages which may be employed to create a software program designed to implement and perform the methods of the present invention. The programs can be structured in an object-orientation using an object-oriented language such as Java, Smalltalk or C++, and the programs can be structured in a procedural-orientation using a procedural language such as COBOL or C. The software components communicate in any of a number of means that are well-known to those skilled in the art, such as application program interfaces (API) or interprocess communication techniques such as remote procedure call (RPC), common object request broker architecture (CORBA), Component Object Model (COM), Distributed Component Object Model (DCOM), Distributed System Object Model (DSOM) and Remote Method Invocation (RMI). However, as will be appreciated by one of ordinary skill in the art upon reading this disclosure, the teachings of the present invention are not limited to a particular programming language or environment.

CONCLUSION

The above systems, devices and methods have been described, by way of example and not by way of limitation, with respect to systems, devices and methods for integrating GPS receiver technology into a PDA. As such, the present invention allows electronic maps and GPS capabilities to be integrated with PDA functions. The present invention integrates PDA address book functions with an electronic map that has GPS capabilities.

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement which is calculated to achieve the same purpose may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or variations of the present invention. It is to be understood that the above description is intended to be illustrative, and not restrictive. Combinations of the above embodiments, and other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention includes any other applications in which the above systems, devices and methods are used. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.